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VLIYANIYE USLOVIY RAZLICHNOY SOLENOSTI I TEMPERATURY NA TEMP
ROSTA KOLONIY KORKOVOY MSHANKI LEPRALIA PALLASIANA MOLL.

- (The Effect of Various Salinity and Temperature Conditions on
the Growth Rate of Lepralia pallasiana Moll. Colonies)

by

R. G. Simkina and Ye. P. Turpayeva

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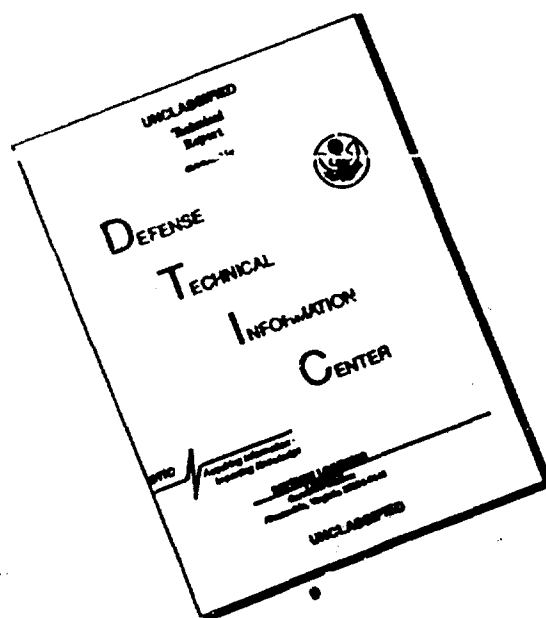
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ABSTRACT

The paper discusses experiments on the reaction of the bryozoan Lepralia pallasiana to variations of water salinity and temperature.

The effect of salinity variations on the species was investigated in containers containing Black Sea water with normal salinity (18 ‰) and reduced salinities 14, 12 and 10 ‰ at the usual temperature in summer (20-24°C).

The effect of temperature variations on the species was investigated in winter at temperatures 25, 15 and 10°C in waters having the salinities of 18, 14, 12, and 10 ‰.

On the basis of the tests it was disclosed that within the salinity range from 18 to 12 ‰ at the usual summer temperature the growth of the bryozoans can be considered as normal, whereas with the salinity of 10 ‰ the growth and germination ceases. As to the variations in temperature, it was found that at 15°C the growth is greatly retarded and at 10°C it ceases.

The combined effect of variations in salinity and temperature increased the retardation of growth so that the growth rate of L. pallasiana at a salinity reduced to 12 ‰ and temperature to 15°C was 14 times slower than at 25°C, but at 10 ‰ and 15°C it was 30 times slower than at 18 ‰.

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THE EFFECT OF VARIOUS SALINITY AND TEMPERATURE CONDITIONS ON
THE GROWTH RATE OF LEPRALIA PALLASIANA MOLL. COLONIES

Experimental studies in the biology of marine invertebrates has repeatedly attracted the attention of investigators either with a view to elucidating the prospects of their acclimatization, or in connection with the necessity for preparing forecasts relative to changes in the fauna of a water basin after the river influx into it has been regulated. Such investigations were carried out mainly in our southern brackish seas, examining mainly the reaction of benthonic marine invertebrates to various degrees of salinity (Zenkevich, 1938; Belyayev and Birshteyn, 1946; Karpevich, 1946, 1947, 1953, 1955; Maksimova, 1953; Nikitin and Turpayeva, 1957 and others). The investigations of marine organisms composing the biological fouling on ships and hydrotechnical structures, which due to their biology are confronted with fluctuations in the external medium, were launched only in recent years. This paper discusses the effect of a water with reduced salinity and different temperature, relative to that of the Black Sea, on the growth rate of L. pallasiana colonies which are frequently found in the biological fouling of the Black Sea.

The investigations were carried out at the Black Sea Experimental Station of the Institute of Oceanology of the Academy of Sciences of USSR in 1955-1956.

The experiments aimed at determining the reaction of L. pallasiana to various salinities were conducted in Black Sea water with a salinity of about 18 ‰ (control) and with reduced salinities to 14, 12, and 10 ‰ at the usual summer temperature--namely, 20 to 24°. The transfer of animals to water having a reduced salinity was gradual, reducing the salinity by 2 ‰ in two days (Karpevich, 1947).

Experiments designed for studying the effect of various temperatures were carried out at 25, 15, and 10°C in water having the salinity degrees of 18, 14, 12, and 10 ‰. Prior to the beginning of observations the animals were kept at natural temperature--namely, 6 to 8°C, whereby the temperature was increased gradually by 2°C in a day. The experiments lasted for 40 to 80 days.

The glass objects with young colonies of L. pallasiana were placed into containers filled with sea water having various salinities so that the number of colonies in each container was not smaller than twenty. Once in ten days the number of eggs in all of the colonies was counted and the growth was calculated. The effect of various salinities on the growth of L. pallasiana was investigated in containers with running water.

In order to determine the status of the bryozoans in the containers, special observations on the rate of growth of *L. pallasiana* in the sea (Rybatskaya bukhta) were carried out. When studying the effect of various temperatures, the animals were kept in containers without running water because it was impossible to provide running water of a given temperature at the Black Sea stations. The containers with test animals were placed in controlled temperature boxes where the water temperature fluctuated within the limits of 2°C. The water in the containers was changed twice a day. All of the animals were fed on algae *Prorocentrum mikans* (micans) and *Exuviella marina*. Sometimes the feces of bivalve mollusks were added to the above algae.

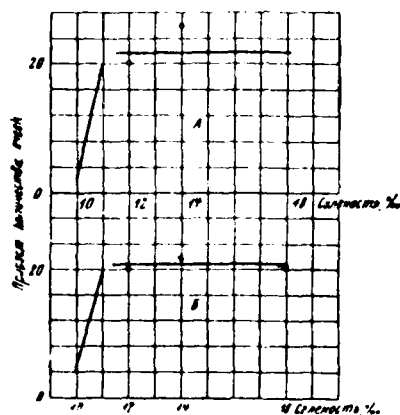


Fig. 1. Increments of *L. pallasiana* in water with various salinities.

A--on the basis of samples obtained in 1955; increment from 30th to 55th day of experiment; B--on the basis of samples obtained in 1956; increment from 40th to 60th day of experiment.

Key. Abscissa: salinity, ‰
Ordinate: increase in the quantity of eggs.

Salinity. In order to study the effect of salinity on the growth of L. pallasiana colonies, five series of experiments were set up; however, only two of them should be considered successful. The results of the three remaining series are not given here because the greater portion of the colonies died during the experiment. Fig. 1 shows the increments of L. pallasiana colonies in water with various salinities in accordance with experiments conducted in 1955 and 1956. The graphs were based on data concerning the increments of the bryozoan colonies after they had been kept in containers for one to one and a half months. This gives assurance that the utilized results are associated with animals that have been completely adapted to the salinity of the experiment. The resultant data show that the growth rate of bryozoan colonies within the salinity range of 18 to 12 ‰ is approximately the same. The deviations from the standard (18 ‰) that are observed at 14 and 12 ‰ lie, in our opinion, within the limits of individual fluctuations and errors of experiment. As to the growth rate at 10 ‰, it drops abruptly. In 1955, the increment at this salinity was 9%, but in 1956 it was 20% of the standard. All this makes it possible to consider the salinity of 10 ‰ as sublethal for L. pallasiana, whereas the salinity range from 12 to 18 ‰, within which the growth rate is about the same, is to be considered as favorable for the species.

Thus these data on the effect of various salinities on the growth rate of L. pallasiana colonies are in complete agreement with the preceding investigations (Treps, 1929; Karavich, 1955; Soldatova, 1961; Turpayeva, 1961) showing that, within the limits of favorable salinity range, the physiological processes of organisms are normal. This regularity was established by the above-mentioned authors on the basis of several biological indexes concerning the status of the organism: on the basis of growth rate, intensity of oxygen consumption, of maturing sexual products, of spawning, and the development of larvae. Regrettably, it should be noted that the only study known to us, which discusses the reaction of the Black Sea L. pallasiana to various salinities in connection with oxygen consumption (Arbuzova, 1957), does not mention such a regularity. According to data by the author, the oxygen consumption of L. pallasiana invariably decreases with the reduction of salinity. /202

Such data, which were contradictory to the results of investigations pointed out above, were obtained by Arbuzova, evidently, as a result of short-term tests that were carried out with animals which had not yet been adapted to the new salinity conditions. A considerable displacement of the level of physiological processes with changes in salinity and the subsequent equalization of the processes to standard level has already been pointed out by us (I. N. Soldatova and E. P. Turpayeva, 1960) for two species--namely, Mercierella enigmatica Fauvel and Teredo navalis L. A similar phenomenon is evidently present in the case of L. pallasiana. This is confirmed by data obtained by us with respect

to changes in the growth rate of L. pallasiana during the first month of the experiment (Fig. 2). It is seen in the graph that in the first month after the animals have been subjected to new salinity conditions the growth process of the bryozoans is inhibited, the period lasting for 20 to 30 days. After the end of the period, the adaptation of animals to the new conditions of salinity is, evidently, taking place, and the growth rate of L. pallasiana in a water having the salinities of 14 and 12 ‰ is almost comparable to the control rate.

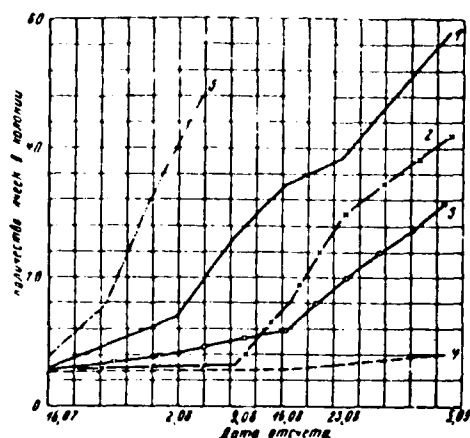


Fig. 2. The growth of L. pallasiana in water with various salinities (according to data of 1955).

1--18 ‰; 2--14 ‰; 3--12 ‰;
4--10 ‰; 5--in the sea.

Key. Abscissa: date of observation
Ordinate: number of eggs in colonies.

Thus, in the salinity range from 18 to 12 ‰ at normal summer temperature the development of individuals of L. pallasiana colonies occurred at a normal rate; the gemination rate in this salinity range appeared to be approximately the same. With 10 ‰ the gemination and growth of colonies practically ceases, whereby yellow bodies are formed in the greater portion of eggs of the colonies. The resultant data make it possible to assume that the salinity of 12 ‰ and more is favorable to a normal life of the Black Sea L. pallasiana.

Temperature. Experiments for the study of the temperature effect on the growth rate of *L. pallasiana* were carried out in the winter of 1955-1956 and they lasted 40 days. The results of the tests have been presented in Table 1 and on the graph in Fig. 3.

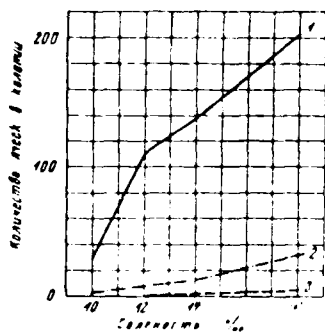


Fig. 3. General increment of *L. pallasiana* colonies in water having various salinities at various temperatures.

1--25°C; 2--15°C; 3--10°C

Key. Abscissa: salinity
Ordinate: the number of eggs in colonies.

It need be noted that because of a small quantity of samples it was not expedient to calculate the results by ten-day periods. In this case we shall limit ourselves to giving the end results only, though this does not enable us to account for the time period during which the adaptation of bryozoans to reduced temperature has occurred. As is seen in Table 1 and Fig. 3, the greatest increase of colonies was observed at 25°C, i.e., at summer temperature. A break in the curve at this temperature is observed between 12 and 10 ‰, which supports the data listed above relative to the effect of salinity on the growth rate of *L. pallasiana*. With 15°C, the growth rate in all the investigated salinity conditions was greatly reduced; further, at this temperature we did not observe a noticeable break in the curve. The temperature of 10°C practically stops the growth of the Black Sea *L. pallasiana* colonies.

Thus, the drop of temperature, as well as the decrease of salinity, retards greatly the growth process and, when reaching certain limits, may also stop the process despite the fact that all the other factors are completely favor-

able (the growth of *L. pallasiana* at 18 ‰ and 10°C, for instance).

It need be noted that the combination of both of the factors--the temperature and salinity--retards more the growth of *L. pallasiana* than each of the factors separately. Thus, the growth rate of *L. pallasiana* colonies in water having the salinity of 18 ‰ at 15°C appeared to be six times slower than at 25°C (16.8%, Table 1), but in water having a salinity of 12 ‰ at 15°C the rate was 11 times slower than at 25°C (7.3%). In water having a salinity of 10 ‰ at 25°C the growth rate of *L. pallasiana* is retarded approximately six times, but at 15°C more than 30 times in comparison with the growth rate at the salinity of 18 ‰.

Table 1

INCREMENT OF *L. PALLASIANA* AT VARIOUS TEMPERATURES AND SALINITIES (GENERAL INCREASE IN THE QUANTITY OF EGGS FOR TEN COLONIES: THE LENGTH OF THE EXPERIMENT WAS 40 DAYS)

Salinity, ‰	Temperature, °C			Relationship, %	
	25 (I)	15 (II)	10 (III)	II:I	III:I
18	202	34	3	16.8	1.5
14	138	15	3	10.9	2.2
12	110	8	1	7.3	0.9
10	31	1	0	3.2	0

Such a considerable retardation of growth of *L. pallasiana* with changes of two factors in the environment occurs, however, in cases when both of the factors vary within the favorable range. In cases when one of the changing factors reaches a limit that is unfavorable for the given species, the effect of the other factor remains unnoticed. /204

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